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Modelling, Uncertainty and Sensitivity Analysis of the Batch Thermal Hydrolysis of Vegetable Oils

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The oleochemical industry is of key relevance to food and cosmetic manufacturers as well as it represents a sustainable source of chemicals and liquid fuel. It is therefore of considerable interest to improve the understanding of design and operating variables that increase the feasibility of vegetable oil utilization. Modelling of batch systems is important for the industrial application of the fat/oil splitting process, because it provides information that could be used to compare different modelling approaches under different operating conditions for producing fatty acids.

In this paper, a rigorous kinetic and mass transfer model describing the batch hydrolysis of vegetable oil at subcritical conditions is presented. The developed model was further investigated using Monte Carlo simulations to statistically quantify the variability in the model outputs due to uncertainties in the parameter estimates. To understand which input parameters are responsible for the output uncertainty, a global sensitivity method (Morris screening) was used. The results from the sensitivity analysis helped to identify what parameters are influential to the model outputs, giving insight into how well the model predicts the concentrations of fatty acids and glycerol; which forms the basis for any model-based decision making for detailed process characterization, design, optimization and operation of the fat/oil splitting process.

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